Session 1 Overview

Particulate Cleanup Applications

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The objective of any developing technology is its application in a commercial environment. High temperature particulate cleanup applications have been applied to commercial systems for over 20 years with varying degrees of success. However, great strides in the reliability of these filter systems have been made in the last ten years as more filter systems have been installed and operated. As the technology is successfully implemented in a wide range of challenging gas cleanup applications, other organizations will evaluate the possible implementation of this technology in their process. With continued implementation, high temperature gas filtration will evolve into a mature and reliable technology.

This session contains thirteen papers covering a wide range of industrial processes. As in past sessions on high temperature particulate cleanup applications, there are papers on pressurized coal combustion applications and three on coal gasification applications. What is especially encouraging is that the technology is spreading to other technologies where it is being used to filter a wide variety of gases. Also, in this session are three papers explaining alternative technologies that can be used commercially.

Pressurized Combustion

Particulate cleanup at high temperatures in combustion applications has proven to be challenging. One approach that has worked well in several units has been to remove the particulate using cyclones. In China, work has been underway on a 15 MWe PFBC-CC unit where the particulate has been successfully removed down to six microns by using two cyclones in series.

A very high temperature system involves the removal of molten particulate and alkali compounds at the 1 MW pressurized pulverized coal combustion Steag facility in Germany. This project has successfully removed particulate down to 3 microns at 1400°C (2550°F) using a granular bed filter. The project is now evaluating ways to further reduce the particulate loading and alkali of this gas stream using some rather novel approaches.

Probably the most successful of the pressurized combustion facilities using particulate removal is the 71 MW PFBC at Wakamatsu in Japan. This facility has operated for over

11,500 hours using cyclones and a full-scale ceramic tube filter for gas cleanup. Many of the challenges that the facility faced during start-up have been resolved increasing the availability of the pressurized combustor.

Gasification

The transport reactor gasifier at the University of North Dakota's Energy and Environmental Research Center has performed over 2000 hours of parametric gasification on their filter system. The 19-element filter system has tested several different types of filter elements under a range of coal gasification conditions to demonstrate acceptable particulate collection efficiency, filter differential pressure, cleanability and durability.

The Power Systems Development System (PSDF) also uses a transport gasifier to evaluate the performance of a Siemens Westinghouse 91-element filter system. The PSDF has operated for over 2300 hours in gasification and has demonstrated consistent particulate loadings below 0.1 ppmw. Twenty different types of filter elements have been evaluated in gasification to date, and failsafe development and testing is an active part of the test program.

One of the largest filter systems in the world operates downstream of the Shell gasification unit at the Buggenum facility in the Netherlands. This 253 MW power plant has been in full commercial operation since 1998. The filter system was developed by SCHUMACHER and contains 864 ceramic filter elements. To date, this facility has operated for over 25,000 hours without any measurable dust on the clean side. Also, the elements in this system have been in operation for over 15,000 hours.

Industrial Applications

Several filter systems have made their way into industrial process including the filter system on Mikropul France's ferro alloy blast furnace. This unit went commercial in 2001 and replaced a wet scrubber system to clean the off-gas of a blast furnace. The gas filter has allowed the unit to increase the furnace output, control the emissions, and has operated with high availability.

Another application for an industrial filter is on the Takuma Company/Kyocera Corp incinerator. This unit has used cordierite filters in a hot gas filter to remove particulate from a gas stream at 800°C (1470°F). The operation of the filter system was stable and had a high particulate collection efficiency. In addition, almost 75% of the dioxins were removed from the gas stream by the filter system.

Tenmat Limited has been evaluating the application of their FIREFLY hot gas filter elements on a wide range of atmospheric pollution control systems including soil remediation, clinical waste incineration and aluminum recycling.

A bag filter system was successfully retrofitted with ceramic elements for removing particulate from the gas stream of an abrasive manufacturing plant by Goyen Controls. The initial application of the ceramic filters presented several operational challenges, but Goyen Controls successfully modified the system and now the unit operates reliably.

Another system is the Mikro-Dyne Fines Retention Filter System by Procedyne. This system is developed to support industrial processes such as catalyst manufacturing and activation, thermal processing of metal powders and inorganic chemicals by retaining entrained fines in the system and ensuring high product yields. It can operate across a wide range of operating temperatures and under a variety of gas atmospheres.

Alternative Technologies

The Energy and Resources Laboratories, Industrial Technology Research Institute in Taiwan has been developing and testing a moving granular bed filter system for high temperature gas cleanup. This system has been extensively studied to minimize or eliminate the stagnant zones that negatively impact particulate collection efficiency. From these evaluations they have developed inert structures that are improving collection efficiency to greater than 99.3%.

Finally, the University of Karlsruhe and SCHUMACHER have been developing the Coupled Pulse Pressure (CPP) hot gas filter system. In this system, the pulse gas is coupled directly to the filter element, which provides a high intensity pulse for cleaning using a very low reservoir pressure. In addition, the unit has a safety filter for each filter element which is used in the event a filter element fails. Testing for over 1200 hours has occurred in a six element unit at the University of Karlsruhe